M.Sc. ARTIFICIAL INTELLIGENCE

PROGRAMME STRUCTURE AND SYLLABUS
2020-21 Admissions Onwards

(UNDER MAHATMA GANDHI UNIVERSITY PGCSS REGULATIONS 2019)

EXPERT COMMITTE (M. Sc. ARTIFICIAL INTELLIGENCE)
MAHATMA GANDHI UNIVERSITY

M.Sc. Artificial Intelligence

1. Aim of the Programme

M.Sc. in Artificial Intelligence is a 2- year long postgraduate programme divided into 4 semesters, spread over 6 months each. This programme is designed to familiarize enrolled students with the science and engineering of making computer machines able to perform tasks which normally require human intelligence. It is a branch of the Computer Science that aims to develop intelligent computer machines. This program focuses on building a broad grasp upon foundations in Computer Science, deep understanding of the area of specialization, an innovative ability to solve new problems, and a capacity to learn continually and interact with trans-disciplinary groups.

This programme is designed to create skilled professionals who can cater to the needs of government, industry and scientific organizations in the Computer Science and Machine Intelligence related areas. One can expect jobs at public and private sectors for Artificial Intelligence Agencies, Robotics companies and Coordinating Committee for Artificial Intelligence, and many more upon successful completion of the course.

2. Programme Objective

The objective of this programme is:

- To impart theoretical and practical knowledge in the specialized area of Artificial Intelligence.
- This is the branch of computer science and engineering that specializes in making computer machines able to perform tasks which normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation of languages.
- This programme is also designed to expose students to the frontiers of AI-intensive computing and information systems, while providing a sufficiently strong foundation to encourage further research.

3. Eligibility for Admissions

The eligibility for admission to M Sc Artificial Intelligence programme offered by Mahatma Gandhi University is a B.Sc. Degree with Computer Science /Information Technology/ Electronics/ Computer Applications / Cyber Forensics or BCA or B.Tech Degree in Computer Science/ IT/ Electronics or B Sc Degree in Mathematics / Physics / Statistics with Computer Science /Computer Applications as subsidiary/complementary or an equivalent degree from a recognized university, with not less than 55% marks.

4. Programme Structure and Duration

The duration of the programme shall be 4 semesters. The duration of each semester shall be 90 working days. Odd semesters from June to October and even semesters from December to April. There shall be one month semester break each in November and May.

A student may be permitted to complete the programme, on valid reasons, within a period of 8 continuous semesters from the date of commencement of the first semester of the programme. The programme shall include two types of courses, Core courses and Elective Courses

There will be four core courses and one practical course per semester for the first three semesters. In the last semester there will be one core course, two elective courses to be selected from two separate groups and one project. At the end of the programme, there will be a comprehensive viva-voce which covers questions from all courses in the programme.

5. Job Opportunities and Industrial Demand of this Course

Artificial Intelligence or AI career opportunities have escalated recently due to its surging demands in industries. A career in AI looks more promising than any other jobs available these days. Artificial intelligence is rapidly entering our daily lives in the form of driverless cars, automated online assistants and virtual reality experiences. The demand for talented AI professionals is more than doubling in the last few years, there are limitless opportunities for professionals who want to work on the cutting edge of AI research and development. AI professionals have different job roles; AI data scientist who is liable for gathering data and analyzing it; Machine Learning Engineer who is generally responsible for building and managing platforms for machine learning projects. The job of a machine learning engineer is

at the core of AI projects and is appropriate for the individuals who hail from a foundation in applied research and AI data science.

6. Faculty Under Which The Degree is Awarded

For the MSc Artificial Intelligence programme Mahatma Gandhi University, the degree is awarded under the Faculty of Technology and Applied Science.

7. Specializations Offered

Two specializations are offered by means of two groups of electives with three courses each, spread over the third and fourth semesters of the programme. Any one group can be selected and selection of courses from different groups is not allowed.

Name Of the Programme	Specialization I (Group-A) **Data Science**		Specialization II (Group-B) **Cognitive Science**	
	Course Codes	**Name of the Courses**	**Course Codes**	**Name of the Courses**
M. Sc. Artificial Intelligence	AI 800301	Social Media Mining	AI 810301	Speech Recognition
	AI 800302	Bioinformatics	AI 810302	Natural Language Processing (NLP)
	AI 800403	Big Data Analytics	AI 810403	Computer Vision
	AI 800404	Internet of Things	AI 810404	Machine Translation
	AI 800405	Semantic web	AI 810405	Robotic Systems and Robot Programming
	AI 800406	Information Retrieval and Management	AI 810406	Expert Systems

8. Compliance with the UGC Minimum Standards for the Conduct and Award of Degree

The programme is offered in accordance with the UGC Minimum Standards for the Conduct and Award of Post Graduate Degrees. A student has to secure 80 credits to complete the programme successfully.

Curriculum Design Abstract

SEMESTER I

AI 010101 Computer Architecture and Parallel Programming

AI 010102 Introduction to Artificial Intelligence

AI 010103 Database technology and NoSql

AI 010104 Mathematical Foundations of AI

AI 010105 Software Development Lab- I

a) OOP using Java

b) Database Technology Lab (Mysql & Mongodb)

SEMESTER II

AI 010201 Statistical Computing

AI 010202 Soft Computing

AI 010203 Data mining Techniques

AI 010204 Data Structures and Algorithm Analysis

AI 010205 Software Development Lab- II

a) Soft Computing using Python

b) Statistical Techniques with R

SEMESTER III

AI 010301 Machine Learning

AI 010302 Introduction to Data Analytics

AI 010303 Pattern Recognition

AI 8*0301 Elective 1

AI 010304 Software Development Lab- III

a) Mini Project

b) Data analytics with R

SEMESTER IV

AI 010401 Digital Image Processing

AI 8*0402 Elective 2

AI 8*0403 Elective 3

AI 010402 Main Project

AI 010403 Viva voce

Elective I Group A-Data Science

AI 800301 Social Media Mining

AI 800302 Bioinformatics

AI 800403 Big Data Analytics

AI 800404 Internet of Things

AI 800405 Semantic Web

AI 800406 Information Retrieval and Management

Elective II Group B- Cognitive Science

AI 810301 Speech Recognition

AI 810302 Natural Language Processing (NLP)

AI 810403 Computer Vision

AI 810404 Machine Translation

AI 810405 Robotic Systems and Robot Programming

AI 810406 Expert Systems

SCHEME

Sem	Course Code	Course Name	Course Type	Teaching hours per week		Credits	Total credits
				Theory	Practical		
I	**AI 010101**	Computer Architecture and Parallel Programming	Core	4		4	19
	AI 010102	Introduction to Artificial Intelligence	Core	4		4	
	AI 010103	Database technology and NoSql	Core	4		4	
	AI 010104	Mathematical Foundations of AI	Core	5		4	
	AI 010105	Software Development Lab- I a) OOP using Java b) Database Technology Lab (Mysql & Mongodb)	Core		8	3	
II	**AI 010201**	Statistical Computing	Core	4		4	19
	AI 010202	Soft Computing	Core	5		4	
	AI 010203	Data Mining Techniques	Core	4		4	
	AI 010204	Data Structures and Algorithm Analysis	Core	4		4	
	AI 010205	Software Development Lab- II a) Soft Computing using Python b) Statistical Techniques	Core		8	3	

		with R					
III	**AI 010301**	Machine Learning	Core	4		4	20
	AI 010302	Introduction to Data Analytics	Core	4		4	
	AI 010303	Pattern Recognition	Core	4		4	
	AI 8*030#	Elective 1	Elective	4		4	
	AI 010304	Software Development Lab- III a) Mini Project b) Data Analytics with R	Core		9	4	
IV	**AI 010401**	Digital Image Processing	Core	5		4	22
	AI 8*040+	Elective 2	Elective	5		4	
	AI 8*040+	Elective 3	Elective	5		4	
	AI 010402	Main Project			10	8	
	AI 010403	Viva voce				2	
						Total	**80**

*=0 or 1 since only one group shall be selected from the elective groups

# indicates 1 or 2 since only one subject can be select from the elective group

+ indicates 3,4, 5 0r 6 since any 2 subjects can be selected from the elective group

Semester 1

AI010101 Computer Architecture and Parallel Programming

Course Objectives

- Understand the difference between the pipeline and parallel concepts.
- Study the various types of architectures and the importance of scalable architectures.
- Study the various memories and optimization of memory.

Module I

Introduction-Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Module II

Parallel Programming-Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Module III

Basic Communication-Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Module IV

Analytical Models of Parallel Programs-Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on

Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication. Programming a heterogeneous computing cluster.

Module V

CUDA Architecture-CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, CUDA Dynamic parallelism.

Text Books and References

1. David Kirk, Wen-mei Hwu ,"Programming Massively Parallel Processors: A Hands-on Approach",Elsevier,3rd Edition, 2016
2. Shane Cook ,"CUDA Programming: A Developer's Guide to Parallel Computing with GPUs" Morgan Kaufman, 2nd Edition,2012
3. Hennessy J. L., D. Patterson, "Computer Architecture – A quantitative Approach", Elsevier, 6th Edition,2017.
4. Dezso Sima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures – A Design Space Approach", Pearson Education India, First Edition,2009.
5. Kai Hwang,"Advanced Computer Architecture Parallelism, Scalability, Programmability", Tata McGraw-Hill, 2nd Edition,2003.
6. John Paul Shen, Mikko Lipasti, "Modern Processor Design – Fundamentals of Superscalar Processors", McGraw-Hill International Edition, 2005.

AI010102 Introduction to Artificial Intelligence

Course Objectives

- Get insights into the basic knowledge of Artificial Intelligence, AI application along with its importance.
- Be familiar with problem representation in symbolic notation.
- Able to understand the algorithmic approach in machine learning and automation.
- Analyze the matching techniques for organizing and manipulating knowledge.

- Predict pattern based on Reasoning.
- Acquire basic knowledge in various fields of AI.

Module I

AI Introduction and History: Defining AI, Acting Humanly (Turing Test Approach), Thinking Humanly(Cognitive Modeling Approach), Thinking Rationally (laws of thought approach), Acting Rationally(Rational Agent Approach); Foundations of Artificial Intelligence. History of AI. AI Problems, Assumptions, Techniques, Level of Model, and Criteria for success. Problems, Problem spaces and Search - Problem Definition, Production systems, Problem characteristics, Production system characteristics.

Module II

Searching Problems: Knowledge Organization and Management - Search and Control Strategies - Examples of search problem, Uniformed or Blind search, Informed search, Searching AND-OR graphs. Matching Techniques -Structures used for matching, Measures for Matching, Matching like patterns, Fuzzy matching algorithm

Module III

Knowledge Representation Schemes : Formalized Symbolic Logics - Syntax and Semantics of Propositional and Predicate logic, Properties of WFFS, Inference rules, Resolution, Non-Deductive Inference Method. Inconsistencies and Uncertainties – Non- monotonic reasoning, Truth Maintenance system, Default reasoning and the closed world assumption. Structured Knowledge - Associative Network.

Module IV

Game Playing- The Minimax search procedure, Adding Aipha Beta cutoffs, Additional refinements. Planning- overview, The Blocks world, components of a planning system, Goal stack planning, Nonlinear planning and Hiearchical Planning.

Module V

Natural language understanding- Why is it hard? Steps in understanding. Learning- Rote learning, Learning by taking advice, Analogical and Explanation based learning, Learning from examples-Winstor's learning program. Expert system architecture, Perception-overview

Text Books and References

1. Stuart Russel and Peter Norvig, "Artificial Intelligence – A Modern Approach", PHI, 4th Edition, 2020
2. Elaine Rich and Kevin Knight, B. Sivasankar Nair,"Artificial Intelligence", Tata McGraw Hill 3rd Edition,2013.
3. Dan W. Patterson, "Introduction to Artificial intelligence and expert system", PHI,3rd Edition,2012 .

AI 010103 Database Technology and NoSql

Course Objectives

- Introduces the basic concepts of a database system and query language.
- Emphasizes the understanding of the fundamentals of relational database systems including data models, database architectures, database manipulations and normalization.
- Provides an understanding of new developments and trends such as distributed database, replication, fragmentation and NoSQL.

Module I

Overview of Database Systems: A Historical Perspective, Files System versus a DBMS, Advantages of a DBMS. Describing and Storing Data in a DBMS : The Relational Model, Levels of Abstraction in a DBMS, Data Independence. Structure of a DBMS.Introduction to Database Design: Entities, Attributes and Entity Sets. Relationship and relationship sets. Additional Features of the ER Model.

Module II

Relational Model: Introduction to the Relational Model. Integrity Constraints over Relations: Primary Key, Foreign Key and General Constraints. E-R Model to Relational Model: Entity Sets to Tables, Relationship Sets to Tables, Translating Relationship Sets with Key

Constraints. Translating Relationship Sets with Participation Constraints, Translating Weak Entity Sets.

Module III

Structured Query Language: Overview of SQL, Basic Queries in SQL, UNION, INTERSECT and EXCEPT, Nested Queries, Aggregate Operators, Null Values,String and Date Functions, Complex Integrity Constraints in SQL, Triggers and Views in SQL, Embedded SQL, Dynamic SQL and Cursors.Relational Database Design Introduction to Schema Refinement, Functional Dependencies, Normal Forms: First Normal Form, Second Normal Form, Third Normal Form, Boyce Codd Normal Form.

Module IV

Transaction Management, Concurrency Control, Distributed System – The ACID Properties of a Transaction, Concurrent Execution of Transactions: Serialisability, Anomalies Due to Interleaved Execution, Schedules Involving Aborted Transactions, Lock-Based Concurrency Control: Strict Two-Phase Locking (Strict 2PL), Deadlocks. Introduction to Crash Recovery: Stealing Frames and Forcing pages, overview of ARIES. Dealing with Deadlocks. Introduction to Distributed Database - Distributed DBMS Architectures, Storing data in a Distributed Databases: Replication, Fragmentation.

Module V

Nosql Data Management - Introduction to NoSQL- Four types of NoSQL Databases - Aggregate data models - Aggregates – Key-Value and Document Data Models – Relationships – Graph Databases – Schemaless Databases –Materialized views – Distribution Models – Sharding – Master-Slave Replication – Peer-Peer Replication.

Text Books & References

1. Raghu Ramakrishnan and Johannes Gehrke,” Database Management Systems”, McGraw Hill, Third Edition,2014.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional,3rd Edition, 2020.

3. Peter Rob, "Database Systems: Design, Implementation and Management", Thomson Learning,9th Edition,2009.
4. Pratt Philip,"Concept of Database Management", Thomson Learning, 5Edition,2004.
5. Silberchatz, Korth and Sudarsan," Database System Concepts" , McGraw Hill, 7th Edition, , 2014
6. James R Groff and Paul N Weinberg, "The Complete Reference SQL" Tata McGraw Hill, Second Edition, 2003.

AI010104 Mathematical Foundations of AI

Course Objectives

This course provides the mathematical concepts of data processing in computers.

Module I

Linear Algebra – System of Linear equations, Solving System of Linear equations, Vectors , Scalars, Addition, Scalar multiplication, dot product, vector projection, cosine similarity, Linear Independence.

Module II

Orthogonal vectors, normal and orthonormal vectors , vector norm, vector space, linear combination, basis of vectors, Affine spaces

Module III

Matrices – Determinant, Identity matrix, Inverse of a matrix, Rank of a matrix, Nullity, Trace of a matrix, Eigen values, Eigen vectors, Matrix decompositions.

Module IV

Differentiation, rules of differentiation, Derivatives, Scalar derivatives, Partial derivatives, Principle Component analysis – Concepts and properties. Dimensionality reduction with PCA

Module V

Differentiation of univariate functions, Partial differentiation and gradients, Gradient of vector valued function. Gradient of matrices. Optimization using gradient functions, Constrained optimization and Lagrange multipliers. Convex optimization.

Text Books & References

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition., John Wiley & Sons, (2014).
3. B. S.Grewal, Higher Engineering Mathematics, 38th Edition. Khanna Publications,(2005).

AI010105 Software Development Lab- I

a) OOPs using Java

Module I

Basics of Java: Programming concepts, Array implementation, Strings, Reading input from keyboard Introduction to Object Oriented Programming concepts : Classes, Methods, Constructors, access specifiers, Encapsulation, Polymorphism, Method & constructor overloading, Inheritance and its different types, super keyword, abstraction through abstract classes

Module II

Interfaces and Packages- Built in and user defined packages, access protection in packages Exception handling- basic concepts, types of exception, user defined exception Multithreading Programming - Defining threads, Life cycle, creating single and multiple threads, Thread priorities, Synchronization File handling - Built in methods, Reading , writing, copying and appending a file.

Module III

Applets - Basics, Life cycle, applet methods, applet tag, passing parameters to applet, adding image file to applet, Working with Graphics, AWT Controls and Text : Graphics programming, Color class, Font class, Font Metrics

Module IV

Swings - Introduction, Hierarchy of classes, Controls with event handling , Layout Managers ,Menus -Menubars, submenus, Dialog boxes, File Dialog

Module V

Database Connectivity - JDBC overview, JDBC implementation & its architecture, Establishing connectivity and working with connection interface, Working with statements, Creating and executing SQL statements, Working with Result Set .

Lab Record Programs for Object oriented programming with Java

Demonstrate the Java application programs using any advanced text editors or frameworks. All students are expected to develop minimum 30 programs (simple and complex) in the lab

1. Develop programs based on OOPs concept (6)
2. Inheritance programs –single and multilevel(2)
3. Implement interface concept
4. Programs to implement the usage of packages(2)
5. Programs to implement exception(2)
6. User defined exception
7. Multithreaded programming and synchronization(2)
8. Programs for handling file operations (2)
9. Applet basic programs –graphics programming, passing parameters, display image, simple moving banner (4)
10. Illustrate Event handling programs
11. Implement the java programs using Swing controls(4)
12. Database connectivity using swing
13. Socket programming-chat server
14. Develop a GUI application

b) Database Technology Lab (Mysql & Mongodb)

Database concepts: Open source database software: MySQL features MySQL data types: Numeric, date & time, string Table creation in MySQL: insert, select, where clause, ordering the result, like operator Selecting Multiple tables: using join, using queries Modifying records: update command, replace command, delete command date & time functions in MySQL, Database creation, table creation, insertion, updation, deletion and select command.

1. Write a MongoDB query to display all the documents in the collection restaurants.
2.Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine for all the documents in the collection restaurant.
3.Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine, but exclude the field _id for all the documents in the collection restaurant.
4. Write a MongoDB query to display the fields restaurant_id, name, borough and zipcode, but exclude the field _id for all the documents in the collection restaurant.
5. Write a MongoDB query to display the entire restaurant which is in the borough Bronx.
6.Write a MongoDB query to display the first 5 restaurant which is in the borough Bronx.
7.Write a MongoDB query to display the next 5 restaurants after skipping first 5 which are in the borough Bronx.
8.Write a MongoDB query to find the restaurants who achieved a score more than 9.
9. Write a MongoDB query to find the restaurants that achieved a score, more than 80 but less than 100.
10. Write a MongoDB query to find the restaurants which locate in latitude value less than -95.754168.
11.Write a MongoDB query to find the restaurants that do not prepare any cuisine of 'American' and their grade score more than 70 and latitude less than -65.754168.
12.Write a MongoDB query to find the restaurants which do not prepare any cuisine of 'American' and achieved a score more than 70 and not located in the longitude less than -65.754168.
13. Write a MongoDB query to find the restaurants which do not prepare any cuisine of 'American ' and achieved a grade point 'A' not belongs to the borough Brooklyn. The document must be displayed according to the cuisine in descending order.

14. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which contain 'Wil' as first three letters for its name.

15.Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which contain 'ces' as last three letters for its name.

Semester II

AI010201 Statistical Computing

Course Objectives

- To learn the probability distributions and density estimations to perform analysis of various kinds of data.

Module I

Probability Theory and Probability distributions - Sample space and events- Axioms of probability- Sample spaces having equally likely outcomes- Conditional probability- Bayes Theorem- Independent events-Random variables- Probability distribution of random variables – Discrete and continuous random variables- Mean and Variance of a Random variable- Binomial-Poisson and Normal distributions-Fitting of Binomial, Poisson and Normal distribution- Distributions arising from Normal distribution

Module II

Sampling Distribution- The sample mean- The central limit theorem- The sample variance- Sampling distributions from a Normal population- Distribution of sample mean- Joint distribution of sample mean and variance- Sampling from a finite population

Module III

Testing of Hypothesis- Significance level- Test concerning the mean of a Normal population- Testing the equality of two Normal population- Hypothesis tests consist of concerning the

variance of Normal population- Hypothesis tests in Bernoulli populations- Tests concerning the mean of Poisson distribution

Module IV

Regression- Least square estimators of the regression parameter- Distribution of the estimators- The coefficient of determination and the sample correlation coefficient- Multiple linear regression- logistic regression- Poisson regression

Module V

Analysis of Variance- One way analysis of variance- Two factor analysis of variance- Two way analysis of variance with interaction

Text Book & References:

1.Sheldon M. Ross,"Introduction to Probability and Statistics for Engineers and Scientists", 3 rd edition

AI 010202 Soft Computing

Course Objectives

- Neural Networks, architecture, functions and various algorithms involved.
- Fuzzy Logic, Various fuzzy systems and their functions.

Module I

Introduction- Artificial Neural Network, Fuzzy Logic, Genetic Algorithm, Hybrid Systems, Soft Computing, Artificial Neural Network- Fundamental Concept, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch–Pitts Neuron, Linear Separability, Hebb Network, Application Scope of Neural Networks

Module II

Supervised Learning Network- Introduction, Perceptron Networks– Learning rule – Training and testing algorithm, Adaptive Linear Neuron(Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network– Architecture, Training algorithm, Radial Basis Function Network, Time Delay Neural Network, Functional Link Networks, Tree Neural Networks, Wavelet Neural Networks Perceptron networks, Adaptive Linear Neuron,

Module III

Associative Memory Networks- Introduction, Training Algorithms for Pattern Association, Autoassociative Memory Network, Heteroassociative Memory Network, Bidirectional Associative Memory (BAM), Hopfield Networks, Iterative Autoassociative Memory Networks, Temporal Associative Memory Network

Module IV

Introduction to Fuzzy Logic- Classical Sets and Fuzzy Sets, Introduction to Fuzzy Logic, Classical Sets (Crisp Sets), Fuzzy Sets

Classical Relations and Fuzzy Relations- Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relations, Tolerance and Equivalence Relations, Noninteractive Fuzzy Sets. Membership Function- Introduction, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments

Module V

Defuzzification- Introduction, Lambda-Cuts for Fuzzy Sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relations, Defuzzification Methods

Hybrid Intelligent Systems- Introduction, Neural Expert System, Neuro fuzzy Systems, Adaptive Neuro Fuzzy Inference Systems, Evolutionary Neural Networks, Fuzzy Evolutionary Systems.

Text Book & References

1. S.N.Sivanandam and S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt Ltd, 3rd Edition,2011.
2. S.Rajasekaran, G. A. Vijayalakshami,” Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications”,PHI, 2nd Edition,2011.

3. N. P. Padhy ,"Artificial intelligence and Intelligent Systems", Oxford University Press, 2nd Edition,2007
4. Alexander m Maystal & James S Albus," Intelligent Systems:", John Wiley, First Edition,2002

AI010203 Data Mining Techniques

Course Objectives

- This course deals with evolving multidimensional intelligent model from a typical system.
- Representation of multi dimensional data for a data warehouse
- Discovering the knowledge imbibed in the high dimensional system
- Finding the hidden interesting patterns in data
- Gives the idea to evaluate various mining techniques on complex data objects.

Module I

Introduction To Data Warehousing.- Evolution of Decision Support Systems- Data warehousing Components –Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations.

Module II

Introduction To Data Mining –Data mining-KDD versus datamining, Stages of the Data Mining Process-task premitives, Data Mining Techniques -Data mining knowledge representation – Data mining query languages, Integration of a Data Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies.

Module III

Association Rules- Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods- Apriori Algorithm, Generating association Rules from Frequent Item sets,

improving the Efficiency of Apriori. Mining Frequent item-sets without Candidate Generation.

Module IV-

Classification - Introduction to Classification, Issues Regarding Classification, Classification by Decision Tree Induction: Decision Tree induction, Attribute Selection Measures, Tree Pruning, Bayesian Classification: Bayes' theorem, Naïve Bayesian Classification, Rule Based Algorithms: Using If - Then rules of Classification, Rule Extraction from a Decision Tree, Rule Induction Using a Sequential Covering algorithm, K- Nearest Neighbour Classifiers.

Module V

Clustering- What is Cluster Analysis, Requirements of Cluster Analysis' Types of Data in Cluster Analysis, Categorization of Major Clustering Methods, Partitioning Methods :k-Means and k- Medoids, Hierarchical Method : Agglomerative and Divisive Hierarchical Clustering, BIRCH, ROCK, Chameleon, Density–Based Method: DBSCAN, Grid Based Methods: STING: STatistical Information, Data Mining Applications.

Text Books & References

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition2011.
2. Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", TataMc Graw Hill Edition, Thirteenth Reprint 2008.
3. G. K. Gupta, "Introduction to Data Min Data Mining with Case Studies", Easter EconomyEdition, Prentice Hall of India, 3rd Edition2014.
4. Mehmed kantardzic,"Datamining concepts,models,methods, and lgorithms", Wiley Interscience, 3rd Edition,2019.
5. Ian Witten, Eibe Frank, "Data Mining; Practical Machine Learning Tools and Techniques", Morgan Kaufmann, 4th Edition,2017.
6. George M Marakas, Modern Data Warehousing, Mining and Visualization, Prentice Hal ,India,2nd Edition ,2003

AI010103 Data Structures and Algorithm Analysis

Course Objectives

- To impart the basic concepts of data structures, algorithms and the analysis phase of algorithms.
- To Understand basic concepts, implementation and applications of stacks, queues, lists, trees and graphs ·
- To understand concepts about searching and sorting techniques.
- To be familiarized with various algorithm design strategies.
- To choose the appropriate data structure and algorithm design method for a specified application.

Module I

Introduction: Data Structures, Concepts of Data Structures, Implementation of Data Structures. Algorithms: Definition, Performance analysis– Space complexity, Time complexity- Asymptotic notation, Practical Complexities, Performance Measurement.

Arrays: Ordered lists – representation of array, polynomial addition.

Stacks and Queues: Definition and concepts, Operations on stacks. Application of stacks- Evaluation of arithmetic expression, infix to postfix conversion, evaluation of postfix expressions. Queue:- representation of queue, Operations on queue, Circular queue, Deque, Priority queue, Application of queues.

Module II

Linked List: Singly linked list- Insertion, deletion, traversing and searching. Linked stacks and queues, Doubly linked list- Insertion, deletion, Traverse and Search operations. Trees : Basic terminology, binary trees, binary tree representation, algebraic expressions, binary tree traversals, Binary Search Tree –Insertion and Searching, Balanced Trees – AVL Tree. Graphs: Terminology and representations, Traversals- BFS, DFS.

Module III

Searching and Sorting: Searching – Linear search, Binary search, Comparison of both methods. Sorting – Insertion, Selection, Heap, Radix, Comparison of various sorting methods. Hashing: Hashing Concept, Hash functions, Collision Resolution

Module IV

Divide and Conquer method – General method, Finding the maximum and minimum, Analysis of Binary search, Quick sort and Merge sort.

Greedy Method– The general method, Knapsack Problem, Minimum cost spanning tree- Prim's algorithm

Module V

Dynamic programming Method- General method, Multistage graphs, All pairs shortest paths.

Backtracking:-The general method, The 8-Queens problem.

Branch and Bound- General Method, Least Cost search, control abstraction for LC search.

Text Books & References

1. Ellis Horowitz and Sartaj Sahni ,"Fundamentals of data structures" ,Galgotia, 2nd Edition 2014
2. Lipschutz Seymour, "Data Structures (Schaum's Outline Series)", Tata Mcgraw-hill ,Revised 1st Edition
3. D Samanta ,"Classic data structures" , PHI,2 Edition, 2009.
4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajeshekharan," Fundamentals of computer algorithms" Universities Press , 2008
5. Richard F Gilberg, Behrouz A Forouzan," Data Structures – a pseudocode approach with C", Thomson Learning, 2 Edition., 2005
6. S.K. Srivastava, Deepali Srivastava ,"Data Structures Through C in Depth", , BPB Publications,2nd Edition, 2003.

AI010205 Software Development Lab- II

a) Soft Computing using Python

Module I

Python Data Types: Numbers, Expressions, Variables and Assignments, Strings, List, Python Standard Library, Imperative Programming: Python programs, Execution Control Structures, User-Defined Functions, Python Variables and Assignments, Parameter Passing.

Module II

Text Files: Strings, Formatted Output, Files, Errors and Exception Handling, Execution and Control Structures: if Statement, for Loop, Two Dimensional Lists, while Loop, More Loop Patterns, Additional Iteration Control Statements.

Module III

Defining a New Python Class, User Defined Classes, Designing New Container Classes, Overloaded Operators, Inheritance, User Defined Exceptions, Namespaces: Encapsulation in Functions.

Module IV

Modular Design: Modules, Top-Down Design, Python Modules, Recursion: Introduction to Recursion, Examples of Recursion.

All students are supposed to prepare a lab record (written/printed) with minimum 30 programs.

1. Develop programs based on different data types, control structures and functions (10)
2. Develop programs based on class, constructor and methods (2)
3. Perform file handling operations, modules, Built-in-exceptions and user defined exceptions (5)
4. Implement database connectivity using SQLite
5. Develop web application with static web pages and dynamic web pages using django framework (2)

6. Develop programs for data preprocessing with pandas and numeric analysis using NumPy (5)
7. Develop programs for implementing plots with Matplotlib (2)
8. Develop programs based on Linear regression
9. Implementation of at least one classification algorithm using Scikit-learn
10. Implementation of at least one clustering algorithm using Scikit-learn

b) Statistical technique with R

Introduction to R programming: History of R programming, starting and ending R, R as a scientific calculator , handling package, workspace, inspecting variables, operators and expressions in R, data objects and types, vectors, matrices and arrays, lists and data frames, built-in and user-defined functions , strings and factors, flow control and loops, advanced looping, date and times.

Using R for statistical analysis: Importing data files, exporting data, outputting results, exporting graphs, graphics in R, interactively adding information of plot, performing data analysis tasks. R commands for descriptive statistics, data aggregation, representation of multivariate data, code factorization and optimization, statistical libraries in R.

1. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R.
2. To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R.
3. To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept in R.
4. To perform statistical operations (Mean, Median, Mode and Standard deviation) using R.
5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization
6. To perform dimensionality reduction operation using PCA for Houses Data Set
7. To perform Simple Linear Regression with R.
8. To perform K-Means clustering operation and visualize for iris data set
9. Write R script to diagnose any disease using KNN classification and plot the results.

10. To perform market basket analysis using Association Rules (Apriori).

Semester III

AI 010301 Machine Learning

Course Objectives

- To build the foundation of deep learning.
- To understand how to build the neural network.
- To enable the students develop successful machine learning projects.

Module I

Machine Learning Basics- Learning Algorithms, Capacity, Overfitting and Underfitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent, Building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module II

Deep Networks: Deep Feed forward Networks, Example: Learning XOR, Gradient-Based Learning . Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms, Parameter Norm Penalties , Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning , Multitask Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout .

Module III

Convolutional Neural Networks: Architectures, convolution / pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.

Module IV

Deep Unsupervised Learning: Autoencoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models. Dynamic memory networks.

Module V

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models, Attention models for computer vision tasks. Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics,

Text Book & Reference

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press,First Edition,2016.
2. T. Hastie, R. Tibshirani, and J. Friedman, "Elements of Statistical Learning", Springer, 2nd Edition,2009.
3. D. Koller, and N. Friedman, "Probabilistic Graphical Models", MIT Press,First Edition,2009.
4. Nikhil Buduma and Nicholas Locascio, "Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithms", 1e, Shroff/O'Reilly, 2017
5. Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach", 1e, Shroff/O'Reilly, 2017

AI010302 Introduction to Data Analytics

Course Objectives

- To Familiarize participants with the scope and applications of data analysis
- To impart basic insights to students about use of various Scientific Models in Data Science
- To provide basic insights into data analysis through data mining

Module I

Introduction to Data Science, How to Think about Data,Data science in a Nutshell - Data Preparation Algorithms - Parameter Tuning - Evaluating Results -Data Mining and Functionalities.

Module II

Supervised learning: simple linear regression ,What is "supervised learning?" ,Simple linear regression, The simple linear model, Multiple inferences and simultaneous confidence bands, Regression diagnostics, Weighted least squares (WLS) regression ,Correlation analysis.
Multiple linear regression, Matrix formulation, Weighted least squares for the MLR model, Inferences under the MLR model, Multicollinearity, Polynomial regression, Feature selection, Regularization: ridge regression, Regularization and variable selection: the Lasso.

Module III

Classification-Supervised learning: Logistic regression, Binary classification via logistic regression, Logistic discriminants, Discriminant rule accuracy, ROC curves,Linear discriminant analysis (LDA), Linear discriminant functions, Bayes discriminant/classification rules, Bayesian classification with normal data, Naïve Bayes classifiers ,k-Nearest neighbor classifiers, Tree-based methods , Classification trees ,Pruning , Boosting ,Regression trees .

Module IV

Unsupervised learning: Unsupervised versus supervised learning, Principal component analysis , Principal components, Implementing a PCA ,Exploratory factor analysis ,The factor analytic model , Principal factor estimation ,Maximum likelihood estimation ,Selecting the number of factors Factor rotation , Implementing an EFA , Canonical correlation analysis.

Module V

Support Vector Machine, Decision Tree, Random Forests,SVM: "No" or "Oh No"? - Example: Predicting Heart Disease - Delineating an Optimal Boundary - Decision Tree: Predicting Survival in a Disaster - Example: Escaping from the Titanic - Generating a Decision Tree - Random Forest: Wisdom of the Crowd - Example: Forecasting Crime - Ensembles -Bootstrap Aggregating (Bagging).

Text Books and References

1. Walter W. Piegorsch ,"Statistical Data Analytics Foundations for Data Mining, Informatics, and Knowledge Discovery",Willy , First Edition,2015

2. Davy Cielen, Arno D.B. Meysman, Mohamed Ali "Introducing Data Science",Willy 2nd,edition, 2016.

3. Robert J. Woz, "Data Analytics for Beginners: A Beginner's Guide to Learn and Master Data Analytics"., Createspace Independent Pub , First Edition, 2017)

5. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice,Hall of India, 3rd Edition,2006.

AI010303 Pattern Recognition

Course objectives

- This course deals with pattern recognition which has several important applications.
- For example, multimedia document recognition (MDR) and automatic medical diagnosis are two such.

Module I

Introduction- Machine Perception, Pattern Recognition Systems- Sensing, Segmentation and Grouping, Feature Extraction, Classification, Post Processing. The Design Cycle- Data Collection, Feature Choice. Model Choice- Training, Evaluation, Computational Complexity. Learning and Adaptation- Supervised Learning, Unsupervised Learning, Reinforcement Learning.

Module II

Bayesian Decision Theory- Continuous Features, Two-Category Classification. Minimum-Error-Rate Classification- Minimax Criterion, Neyman-Pearson Criterion. Classifiers, Discriminant Functions, and Decision Surfaces, The Normal Density, Discriminant Functions for the Normal Density. Bayes Decision Theory-Discrete Features. Bayesian Belief Networks

Module III

Maximum-Likelihood and Bayesian Parameter Estimation- Maximum-Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation: Gaussian Case, Problems of Dimensionality, Component Analysis and Discriminants, Hidden Markov Models. Nonparametric Techniques- Density Estimation, Parzen Windows, kn -Nearest-Neighbor Estimation, The Nearest-Neighbor Rule.

Module -IV

Algorithm-Independent Machine Learning- Lack of Inherent Superiority of Any Classifier, Bias and Variance, Resampling for Estimating Statistics, Resampling for Classifier Design, Estimating and Comparing Classifiers

Module-V

Unsupervised Learning and Clustering- Mixture Densities and Identifiability, Maximum-Likelihood Estimates, Application to Normal Mixtures, Unsupervised Bayesian Learning, Data Description and Clustering, Criterion Functions for Clustering, Iterative Optimization, Hierarchical Clustering, On-line clustering, Graph-Theoretic Methods, Component Analysis, Low-Dimensional Representations and Multidimensional Scaling (MDS),

Textbook & Reference Books

1. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley,2nd Edition,2012.
2. K. Fukunaga, "Statistical pattern Recognition",Academic Press,2nd Edition 2013.
3. Devi V.S., Murty, M.N., "Pattern Recognition: An Introduction", Universities Press, Hyderabad, 2011
4. S.Theodoridis and K.Koutroumbas, "Pattern Recognition",Academic Press, 4th Edition, 2009.

Semester IV

AI010401 Digital Image Processing

Course objectives

- To familiarize students with an overview of the basic concepts of Digital Image Processing
- To understand the processes of improving the quality of an image
- To familiarize the students about the concept of slicing a digital image
- To expose the students towards real-world applications of image processing

Module I

Introduction to Image Processing –Nature of Image Processing, Image Processing and Related Fields, Digital Image Representation, Types of Images, Fundamental Steps in Image Processing, Image Processing Applications, Digital Imaging System, Physical Aspects of Image Acquisition – Biological Aspects of Image Acquisition, Review of Digital Camera, Sampling and Quantization, Image Quality, Image Storage and File Formats.

Module II

Digital Image Processing Operations –Levels of Image Processing, Basic Relationship between pixels and Distance Metrices, Classification of Image Processing Operation – Arithmetic and Logic, Geometrical Operations – Translate, Scaling, Zooming, Linear Interpolation, Shearing, Rotation, Reflection, Set Operation, Data Structure and Image Processing Application, Digital Image Transforms – Need for Image Transforms, Types of Image Transforms, introduction to Fourier Transforms, Properties of Fourier Transforms.

Module III

Image Enhancement and Restoration – Image Quality and Need for Image Enhancement, Image Enhancement Point Operations – Linear and Non-Linear Functions – Intensity Slicing, Bit-plane Slicing, Histogram based techniques, Spatial Filtering Concept – Smoothing and Sharpening Filters, Frequency Domain – Smoothing and Sharpening Filters, Image Degradation (Restoration Model) –Categories of Image Degradation, Color Image Processing

fundamental, Color Models – RGB, HSI,HLS, HSV T V color Models-, YUV Model, YIQ Model

Module IV

Image Segmentation and Compression – Introduction, Classification of Image Segmentation Algorithms,, Detection of Discontinuities – Point Detection, Edge Detection, Thresholding , Principle of Region Growing, Split and Merge, Pyramid Quadtree, Image Compression – Fundamentals, Compression Models, Error free Compression – Variable Length Coding, Lossy Predictive Coding, Image Compression Standards – JPEG, MPEG

Module V

Image Morphology –Introduction, Dilation and Erosion, Opening and Closing, Hit and Miss Transform, Basic Morphological Algorithms, Image feature Representation and Description – Introduction, Boundary Representation, Boundary Description, Biometrics Case Studies.

Text Books & References:

1. Rafael.C.Gonzalez & Richard E.Woods, "Digital Image Processing", Pearson Education,4th Edittion,2017.
2. S. Sridhar, "Digital Image Processing", Oxford University Press,2nd Edition,2016

Elective I Group A-Data Science

AI 800301 Social Media Mining

Course Objectives

The main objectives of this course are to:

- To understand how accurately analyze voluminous complex data set in social media and other sources
- To understand the models and algorithms to process large data sets
- To understand social behavior and recommendation challenges and methodologies.

Module I

Social Media Mining: Introduction – Atoms – Molecules – Interactions – Social Media mining Challenges - Graphs - Basics – Nodes – Edges – Degree of Distribution- Types – Directed – Undirected – Weighted - Graph Connectivity - Tress and Forests – Bipartite graphs – Complete Graphs – Sub graphs – Planar Graphs - Graph Representation - Graph Traversal Algorithms – Shortest path algorithms Dijkstra‟s - Spanning tree algorithms – Prims - Bipartite matching – Ford Fulkerson algorithm

Module II

Network Models: Measures – Node : Eigen Centrality – Page Rank – Group Measures – Betweenness centrality - group degree centrality, centrality, and group - Closeness centrality - Node Linking Behavior - Transitivity and reciprocity - Linking Analysis - Cluster coefficient – Jaccard - Case Study : -Modeling small networks with real world model

Module III

Social Media Communities: Social Communities – Member based Detection – Node degree – Node Similarity – Node reachability - Group Based detection methods - balanced – robust - modular – dense - hierarchical - Spectral Clustering : Balanced Community algorithm Community Evolution - Evaluation.

Module IV

Social Network: Information Diffusion – Types - herd behavior - information cascades diffusion of innovation – epidemics – Diffusion Models Case Study – Herd Behavior – Information Cascades Methods – Social Similarity – assortativity – Social Forces - Influence homophily – Confounding - Assortativity measures – Influence measures – Predictive Models

Module V

Recommender System: Recommendation Vs Search – Recommendation Challenges – Recommender algorithms - Content Based Methods- Collaborative Filtering – Memory Based – Model Based – Social Media Recommendation – User friendship – Recommendation Evaluation – Precision – Recall – Behavioral– User Behavior – User – Community behavior – User Entity behavior – Behavioral Analytics – Methodology

Text Book &Reference

1 Reza Zafarani , MohhammadAli Abbasi ," Social Media Mining: An Introduction" , Cambridge press, First Edition,2014 (Free Ebook available http://dmml.asu.edu/smm/chapter)

2 Memon, N., Xu, J.J., Hicks, D.L., Chen, H. (Eds.), "Data Mining for Social Network Data(Annals of Information Systems) ,2nd Edition,2010

3 Lam Thuy Vo, , "Mining Social Media: Finding Stories in Internet Data",No Starch Press,First Edition2019

4. Matthew A. Russel and Mikhail Klassen, "Mining the Social Web: Data Mining",O'Reilly,3rd Edition,2018

5. Gungor,Polatkan, Antonois Chalkiopoulos, P. Oscar Boykin , "Social Media Mining and Analytics",Wiley,First Edition, 2018.

AI 800302 Bioinformatics

Course Objectives

- To understand basic concepts of molecular biology and genetics
- The concepts of computer science that relate to problems in biological sciences,
- Computer as a tool for biomedical research, and important functional relationships from gene data.

Module I

Introduction : Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics - Biological Data Integration System.

Module II

Data Warehousing and Data Mining In Bioinformatics: Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

Module III

Modeling for Bioinformatics: Hidden markov modeling for biological data analysis – Sequence identification –Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling.

Module IV

Pattern Matching and Visualization: Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences.

Module V

Microarray Analysis: Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark - Tradeoffs .

Text Books & References

1. Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", Springer Verlag, First Indian Reprint ,2014.
2. Zoe lacroix and Terence Critchlow, "BioInformatics – Managing Scientific data", Elsevier,First Indian Reprint, 2004
3. Zoe Lacroix and Terence Critchlow, "Bioinformatics – Managing Scientific Data", Elsevier,First Edition, 2004
4. Bryan Bergeron, "Bio Informatics Computing", Pearson Education, Second Edition,2003.
5. Arthur M Lesk, "Introduction to Bioinformatics", Oxford University Press, Second Edition, 2005

AI 810403 Big Data Analytics

Course Objectives

- Demonstrate knowledge of Big Data Analytics concepts and its applications in business
- Demonstrate functions and components of Map Reduce Framework and HDFS.
- Process of developing applications using HBASE, Hive, Pig etc.

Module 1

Understanding Big Data - What is big data; why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics .

Module II

Nosql Data Management - Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – mapreduce – partitioning and combining – composing map-reduce calculations.

Module III

Basics Of Hadoop - Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures

Module IV

Mapreduce Applications- MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in

classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

Module V

Hadoop Related Tools Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Cassandra – cassandra data model – cassandra examples – cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Text Book &References

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley,1st Edition, 2013.
2. Big-Data Black Book, DT Editorial Services, Wiley
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 1st Edition, 2012.
4. Tom White, "Hadoop: The Definitive Guide", O'Reilley, Third Edition,2012.
5. Eric Sammer, "Hadoop Operations", O'Reilley, 1st Edition ,2012
6. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
7. Lars George, "HBase: The Definitive Guide", O'Reilley, 1st Edition, 2011.
8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, Third Edition,2012
9. Alan Gates, "Programming Pig", O'Reilley, 2nd Edition,2016.

AI 810404 Internet of Things(IOT)

Course Objectives

- Able to understand the application areas of IOT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics

Module I

The IoT Networking Core: Technologies involved in IoT Development: Internet/Web and Networking Basics OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, Introduction to Cloud Computing IoT Platform overview Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards. Network Fundamentals: Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's – Access Points, Hubs etc. Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions.

Module II

IoT Architecture: History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols Applications: Remote Monitoring & Sensing, Remote Controlling,Performance Analysis The Architecture The Layering concepts , IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN Security aspects in IoT.

Module III

IoT Application Development: Application Protocols MQTT, REST/HTTP,CoAP, MySQL

Module IV

Back-end Application Designing Apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB Object type Database, HTML, CSS & jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development, Application Development for mobile Platforms: Overview of Android / IOS App Development tools

Module V

Case Study & advanced IoT Applications: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

Text Book &Reference

1. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", Wiley, 1st Edition,2011
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
3. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann

AI 810405 Semantic Web

Course Objectives

- To build and implement a small ontology that is semantically descriptive of your chosen problem domain.
- Implement applications that can access, use and manipulate the ontology.
- Represent data from a chosen problem in XML with appropriate semantic tags obtained or derived from the ontology.
- Depict the semantic relationships among these data elements using Resource Description Framework (RDF)
- Design and implement a web services application that "discovers" the data and/or other web services via the semantic web.
- Discover the capabilities and limitations of semantic web technology for different applications

Module I

Introduction-Introduction to the Syntactic web and Semantic Web – Evolution of the Web – The visual and syntactic web – Levels of Semantics – Metadata for web information - The semantic web architecture and technologies –Contrasting Semantic with Conventional Technologies –Semantic Modeling -Potential of semantic web solutions and challenges of adoption

Module II

Ontological Engineering- Ontologies – Taxonomies –Topic Maps – Classifying Ontologies - Terminological aspects: concepts, terms, relations between them – Complex Objects -

Subclasses and Sub-properties definitions –Upper Ontologies – Quality – Uses - Types of terminological resources for ontology building – Methods and methodologies for building ontologies – Multilingual Ontologies -Ontology Development process and Life cycle – Methods for Ontology Learning – Ontology Evolution – Versioning

Module III

Structuring And Describing Web Resources -Structured Web Documents - XML – Structuring – Namespaces – Addressing – Querying – Processing - RDF – RDF Data Model – Serialization Formats- RDF Vocabulary –Inferencing -RDFS – basic Idea – Classes – Properties- Utility Properties – RDFS Modelling for Combinations and Patterns- Transitivity

Module IV

Web Ontology Language- OWL – Sub-Languages – Basic Notions -Classes- Defining and Using Properties – Domain and Range – Describing Properties - Data Types – Counting and Sets- Negative Property Assertions – Advanced Class Description – Equivalence – Owl Logic.

Module V

Semantic Web Tools And Applications -Development Tools for Semantic Web – Jena Framework – SPARL –Querying semantic web - Semantic Desktop – Semantic Wikis - Semantic Web Services – Application in Science – Business

Text Books & References

1. Liyang Yu, "A Developer's Guide to the Semantic Web", Springer, 2nd Edition, 2014.
2. John Hebeler, Matthew Fisher, Ryan Blace and Andrew Perez-Lopez, "Semantic Web Programming", Wiley; 1 edition, 2009.
3. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer, (Cooperative Information Systems)", MIT Press, 3rd Edition ,2008
4. Robert M. Colomb, "Ontology and the Semantic Web: Volume 156 Frontiers in Artificial Intelligence and Applications (Frontier in Artificial Intelligence and Applications)", IOS Press, 2nd Edition 2012.
5. Dean Allemang and James Hendler, "Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL", Morgan Kaufmann, 2nd edition, 2011.

6. Michael C. Daconta, Leo J. Obrst and Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Wiley; 1 edition 2003
7. Karin Breitman, Marco Antonio Casanova and Walt Truszkowski, "Semantic Web: Concepts, Technologies and Applications (NASA Monographs in Systems and Software Engineering)", Springer; Softcover, 2010.
8. Vipul Kashyap, Christoph Bussler and Matthew Moran, "The Semantic Web: Semantics for Data and Services on the Web (Data-Centric Systems and Applications)", Springer, 1st Edition, 2008.

AI 810406 Information Retrieval and Management

Course Objectives

- To use an open source search engine framework and explore its capabilities
- Represent documents in different ways and discuss its effect on similarity calculations and on search,
- Modify Page Rank and HITS algorithms or Personalization, Semantic or any other aspect,
- Design and implement an innovative feature in a search engine and explain the search components affected by the innovation
- Design a smart information management system with Information Retrieval components

Module I

Introduction-Introduction -History of IR- Components of IR - Issues –Open source Search engine Frameworks, The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.

Module II

Information Retrieval- Boolean and vector-space retrieval models- Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with

sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion

Module III

Web Search Engine : Introduction and crawling, Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta-crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval

Module IV

Web Search – Link Analysis And Specialized Search: Link Analysis –hubs and authorities - PageRank and HITS algorithms -Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & MapReduce - Evaluation - Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling "invisible" Web - Snippet generation, Summarization, Question Answering, Cross-Lingual Retrieval.

Module V

Document Text Mining: Information filtering; organization and relevance feedback – Text Mining -Text classification and clustering - Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM)

Text Books & References:

1. C. Manning, P. Raghavan, and H. Schütze," Introduction to Information Retrieval" , Cambridge University Press, First Edition,2008.
2. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", ACM Press Books,2nd Edition,2011.
3. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, Addison Wesley; First edition 2009

4. Mark Levene, “An Introduction to Search Engines and Web Navigation”, Wiley, 2 edition, 2010.
5. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack,” Information Retrieval: Implementing and Evaluating Search Engines”, The MIT Press, 2010.
6. Ophir Frieder,” Information Retrieval: Algorithms and Heuristics (The Information Retrieval Series)”, Springer; 2nd edition, 2004
7. Manu Konchady, “Building Search Applications: Lucene, LingPipe, and Gate”, Mustru Publishing; First edition,2008

Elective II Group B-Machine Intelligence

AI 800301 Speech Recognition

Course Objectives

- To introduce speech production and related parameters of speech.
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To understand different speech modeling procedures such as Markov and their implementation issues.

Module I

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Module II

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral

Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Module III

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Module IV

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – ngrams, context dependent sub-word units; Applications and present status.

Module V

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Text Books & References

1.Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.

2.Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education.

References

1.Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.

2.Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education.

3.Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.

4.Ben gold and Nelson Morgan, “Speech and audio signal processing”, processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
5.Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press.

AI 810302 Natural Language Processing

Course Objectives

- To tag a given text with basic Language processing features, design an innovative application using NLP components
- Implement a rule based system to tackle morphology/syntax of a Language

Module I

Natural Language Processing tasks in syntax, semantics, and pragmatics – Regular Expressions-Morphology and Finite state Transducers-Finite state Morphological Parsing, N-gram Language Models - Estimating parameters and smoothing – N-grams for spelling and Pronunciation

Module II

Syntax Parsing-Word classes and Part of speech Tagging - Rule-Based Part of Speech Tagging – Stochastic Part of Speech Tagging – Transformation based Models – Other issues. Context-free grammars.

Module III

Parsing with context- free grammars- The Earley algorithm, Finite state parsing methods Features and Unification- Implementing unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs, Language and Complexity

Module IV

Semantic Analysis- Representing Meaning –First order predicate calculus, Related Approaches. Semantic Analysis - Lexical semantics- wordnet –Word-sense disambiguation -

Supervised – Dictionary based and Unsupervised Approaches - Compositional semantics, Semantic Role Labeling and Semantic Parsing

Module V

Pragmatics-Discourse,Reference Resolution, Algorithm for pronoun resolution- A Tree search Algorithm. Text Coherance. Natural Language Generation-Introduction, An architecture for Generation, surface realization, Functional Unification grammar, Discourse planning, other issues

Text Books & References

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing" ,Prentice Hall,3rd edition, 2020

2. Christopher D. Manning and Hinrich Schuetze, "Foundations of Statistical Natural Language Processing" , MIT Press,First Edition,1999

3. Steven Bird, Ewan Klein and Edward Loper," Natural Language Processing with Python", O'Reilly Media; 1 edition, 2009

4. Roland R. Hausser, "Foundations of Computational Linguistics: Human- C o m p u t e r Communication in Natural Language", MIT Press, 3rd Edition,2014 .

5. Pierre M. Nugues, "An Introduction to Language Processing with Perl and Prolog: An Outline of Theories, Implementation, and Application with Special Consideration of English, French, and German (Cognitive Technologies)" ,Springer, softcover reprint of First Edition, 2010

6. James Allen, "Natural Language Understanding", Pearson,2 edition 1995

7. NLTK – Natural Language Tool Kit - http://www.nltk.org/

AI 800403 Computer Vision

Course Objectives:

- To get exposure to the mathematical and computational techniques used in computer vision.
- To develop skills in designing and implementing basic computer vision applications.
- To understand the feature description and extraction methods used in computer vision.

- To understand how to capture and extract relevant visual information from images and videos to automatically interpret the 2D/3D scene.
- To develop a computer based system with vision capabilities

Module I: Imaging and Image Representation: Imaging Devices, 3D structure from 2D images, Five frames of reference. Binary Image Analysis: Pixels and Neighborhoods, Applying masks to images, Counting the objects in an image, Connected components labeling.

Module II: Binary image morphology, Region properties, Region adjacency graphs, Thresholding, Overview of Pattern Recognition and Image filtering concepts.

Module III: Color and Shading: Color bases, Color histograms, Color segmentation, Shading. Texture: Texture, Texels and Statistics, Texel based Texture Descriptions, Quantitative Texture Measures, Texture Segmentation.

Module IV: Content based image retrieval: Image distance measures, Database organization. Motion from 2D image sequences: Computing Motion Vectors, Computing paths of moving points, Detecting significant changes in video. Overview of image segmentation.

Module V: Matching in 2D: Registration of 2D data, Representation of points, Affine mapping functions, 2D object recognition via Affine and Relational Matching. Perceiving 3D from 2D images: Labeling of line drawings from blocks world, 3D cues available in 2D images, Perspective imaging model, Depth perception from stereo. 3D sensing and Object pose Computation: 3D Affine transformations, Camera Model, Affine calibration matrix, Improved Camera calibration method, Pose estimation, 3D object reconstruction.

Text Books:

1. Linda G. Shapiro, George C. Stockman, "Computer Vision", Prentice Hall, 1st Ed., 2001.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 1st Ed., 2010.
3. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Ed., 2011.
4. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 1st Ed., 2012.
5. Ramesh Jain, Rangachar Kasturi, Brian G. Schunck, "Machine Vision", McGraw-Hill, 1st Ed., 1995.

AI 810404 Machine Translation

Course Objectives:

- Describe and critically discuss the architecture of machine translation systems

- Handle basic tools for training and applying machine translation systems.

Module 1

Introduction-MT approaches- Vauquois Triangle, understanding ascending and descending transfer. Three major paradigms of machine translation, MT Evaluation.

Module II

Learning Bilingual word mappings-A Combinatorial Argument, a Naive estimate for corpora requirement, one –to-one alignment, Heuristic based computation, E-M based computation, mathematics of alignment,few illustrative problems, derivation of alignment probabilities, expressing the E and M steps in count form. Complexity considerations, EM-study of progress in parameter values.

IBM model of alignment-factors influencing, IBM Model 1, alignment in a new input sentence pair, translation in IBM Model 1. IBM Model2, Model 3

Module III

Phrase Based Machine Translation- Need for phrase alignment, An example of phrase alignment Technique-two way alignments, symmetrisation, Principles of phrase construction, Phrase Table, Mathematics of Phrase-based SMT-Understanding phrase based translation, deriving translation model, Decoding,Moses-installing, preprocessing, training language model, tuning, evaluation metric.

Module IV

Rule based Machine Translation(RBMT)- Two kinds of RBMT, Universal Networking language, why UNL? Interlingua and word knowledge, UWs and multiwords, UW Dictionary and WordNet. Translation using interlingua, English to UNL conversion.Trasfer based MT.

Module V

Example based Machine Translation-Essential steps, EBMT's working,EBMT and case based reasoning. Text similarity computation, Recombination, EBMT and translation memory, EBMT and SMT

Text Books &References:

1. Pushpak Bhattacharyya,"Machine Translation", CRC Press,1st Edition,2015
2.Philipp Koehn,"Statistical Machine Translation",Cambridge University Press,3rd Edition,2012.
3. Mohammed Hashim,"Machine Translation-Advantages, Disadvantages, Strategies", Research gate,1st Edition,2020

AI 810405 Robotic Systems and Robot Programming

Course Objectives

- The objective of this course is to enlighten the students about the fundamentals of robotic systems.
- To understand the basics of robot, Robot Transformations and Sensors, Micro/Nano robotic systems and to program them for functioning.

Module-I:

Introduction Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.

Module II

End Effectors And Robot Controls- Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

Module III

Robot Transformations And Sensors- Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Module IV

Robot Cell Design And Micro/Nano Robotics System- Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software IntroductionsRobot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Micro/Nanorobotics system overview-Scaling effectTop down and bottom up approach- Actuators of Micro/Nano robotics system-Nanorobot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nanorobot in targeted drug delivery system.

ModuleV

Basics Of Robot Programming- Robot programming-Introduction-Types- Flex Pendant-Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation Interlock commands- Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands. VAL,VAL-II, RAPID AND AML LANGUAGE Robot Languages-Classifications, Structures Operating systems.

Text Books & References

1. Craig. J. J. "Introduction to Robotics mechanics and control", Pearson,3rd Edition,2009.
2. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education.,2nd Edition 2009
3. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2nd Edition,2012
4. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning.,3rd Edition,2009.
5. Deb. S. R. "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, 2nd Edition,2009

6. Mikell. P. Groover, “Industrial Robotics Technology, Programming and Applications”, McGraw Hill Co, 2nd Edition,2012.
7.Klafter. R.D, Chmielewski.T.A. and Noggin‟s., “Robot Engineering : An Integrated Approach”, Prentice Hall of India Pvt. Ltd.,1994.

AI 810406 Expert Systems

Course Objectives

- Explain the architecture of an expert system
- Describe important search techniques and their suitable problem domains.
- Building an expert system

Module I

The meaning of an expert system, problem domain and knowledge domain, the advantages of an expert system, general stages in the development of an expert system, general characteristics of an expert system, history and uses of expert systems today, rule-based expert systems, procedural and nonprocedural paradigms, characteristics of artificial neural systems. - The study of logic, difference between formal logic and informal logic, meaning of knowledge, how knowledge can be represented, semantic nets, limitations of semantic nets, schemas, frames and their limitations, how to use logic and set symbols to represent knowledge, the meaning of propositional and first order predicate logic, quantifiers, imitations of propositional and predicate logic.

Module II

Trees, lattices, and graphs, state and problem spaces, AND-OR trees and goals, methods of inference, rules of inference, limitations of propositional logic, logic systems, resolution rule of inference, resolution systems, and deduction, shallow and causal reasoning, applying resolution to first-order predicate logic, forward and backward chaining, additional methods of reference, Meta knowledge, the Markov decision process.

Module III

The meaning of uncertainty and theories devised to deal with it, types of errors attributed to uncertainty, errors associate, with induction, features of classical probability, experimental and subjective probabilities, compound and conditional probabilities, hypothetical reasoning and backward induction, temporal reasoning, Markov chains, odds of belief, sufficiency and necessity, role of uncertainty in inference chains, implications of combining evidence, role of inference nets in expert systems, how probabilities are propagated.

Module IV

Sources of uncertainty in rules, methods of dealing with uncertainty, Dempster-Shafer theory, theory of uncertainty based on fuzzylogic, commercial applications of fuzzy logic. How to select an appropriate problem, the role of the knowledge engineer in the building of expert systems, the expected life cycle of an expert system, how to do a life cycle model.

Module V

Building an Expert Systems: Necessary requirements for expert systems development, Justification for expert system development, Task in building expert systems, Stages of expert system development, Choosing a tool for building expert system, Acquiring knowledge from the experts, Examples of the expert system building process, examples of expert system used in different areas.

Text books & References

1. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, 4th Edition,2004.
2. Durkin, J., “Expert systems Design and Development”, Macmillan,First Edition, 1994
3. Elias M. Awad,” Building Expert Systems”, West Publishing Company, 4th Edition, 2004
4. Peter Jackson, “Introduction to Expert Systems”, Addison Wesley Longman,3rd Edition, 1999.
5. Gonzalez and D. Dankel, "The Engineering of Knowledge-Based Systems", Prentice Hall,1st Edition 1994.
6. Donald A. Waterman, “.A Guide to Expert Systems.”, Addison-Wesley Publishing Company,1st Edition,1983